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FOREST GROWTH ON ABANDONED AGRICULTURAL LAND

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ALTHOUGH the process of clearing forested land for agricultural uses continues in nearly all sections of our country, another, generally less conspicuous, but almost as important, process occurs along with it—the abandonment of cultivated land and its reversion to forest. This reversion to forest, or "afforestation" as it is called, is of great interest both to the forester and to the agriculturalist. To the former because it helps to replenish the waning timber supply, and to the latter because it provides a means of utilizing lands no longer used for raising crops and grazing.

Reasons for Abandonment of Agricultural Lands.—This abandonment of agricultural lands takes place in all sections, but chiefly in relatively remote although long-settled regions, such as some parts of rural New England. There are several reasons for its abandonment, such as: (1) loss of fertility, an example of which is the abandonment of many acres in parts of New England; (2) change of economic conditions rendering further cultivation unprofitable. The classic example of this is the large cotton acreage in Virginia and the Carolinas abandoned during the Civil War. (3) Discovery that certain lands are not suited for agriculture, at least as it has been practised in the locality. Examples of this are to be found in every region which has been settled for any length of time, where isolated fields in swampy sites, or hilltops, and the like, have been neglected when it has become evident that their cultivation was not profitable. General shifts in rural population from long-settled regions in the east to the west, and to the urban districts, have frequently caused land to be abandoned that was actually good farm land, but on the whole most of the abandoned lands have been of inferior quality.

Favorable Conditions for Tree Growth Found on Abandoned Lands.—Generally speaking, conditions are very favorable for tree growth on abandoned lands. The soil, although possibly worn out from an agricultural point of view, has been refreshed during its period of cultivation in those constituents which make it desirable for tree growth. It is well broken so that the seed can easily reach the soil itself (often a difficult thing in the natural forest) and the roots of the seedlings can easily penetrate it. Seedlings do not have to compete with the older trees for light, moisture and growing space. If the field happens to be turfed over, once the seedlings have become established, the competition of the turf is of no great moment, although it may delay the seeding up of the field considerably in the first place. Because of the lack of inflammable litter on the ground, fire seldom interferes with old field stands, as stands growing upon abandoned lands are commonly called, during their period of establishment. This fact gives such stands a great advantage over stands coming in on cut-over lands, which must frequently cope with severe fires in the slash formed by the old cuttings. The fire hazard may, however, be quite high for old field stands during the middle period of their development, because of their frequent crowding and high density.

These conditions do not favor all trees, as there are certain species which do much better to start with under the shade of other trees, and do not take kindly to the exposed conditions of open fields, but this fact has little bearing on the situation, since it merely rules those particular species out of the race for the capture of clearings. Every humid region seems to have a sufficiency of trees capable of becoming established and growing well under open field conditions.

Influence of Other Vegetation.—Abandoned agricultural lands fall into two classes: (1) Fields not covered with turf, (2) pastures. It frequently happens that when it develops that a field is no longer valuable for crops it is seeded down as a pasture and grazed for a period before its final abandonment. This delays materially the return of the forest, but it comes back in time, nevertheless. In sections where soil erosion is common and turf does not grow especially well, such as is the case in portions of the south, its entire absence may allow such action to get the upper hand and wash away rapidly the seeds and seedlings, so that final recapture is greatly retarded or altogether prevented for long periods. Sometimes, because of close proximity of seed plants or other causes, an abandoned field is quickly seeded up by worthless brush before tree seed has a chance to reach it. This may delay but does not prevent the return of forest conditions. It seems that throughout most of the eastern portion of the United States the forest rather than the grass or brush type of vegetation is the ultimate type, and toward it all types evolve. It is entirely probable that if all the land in the eastern United States were abandoned it would eventually be clothed in forests similar to those found here when the white man came.

Types of Natural Reforestation on Abandoned Lands.—There are two types of recapture—immediate and gradual. In the first case, almost immediately a field is abandoned a young homogeneous even-aged stand springs up over the entire area. In the second the recapture is slow and may extend over many years, the resulting stand being all-aged, in which case some of the seed which goes toward stocking the area is often produced by the earlier arrivals, so that the trees do not all belong to the same generation. On very large clearings the second type must perforce prevail, since seed can not be sown naturally over sufficient area to yield at once a full stand. It sometimes happens that several bands of growth of different ages occur on a field, that farthest from its edge being the youngest. The forester describes such a stand as "even-aged in groups." On average-sized clearings it is generally the case that fields abandoned directly from the plow are reclaimed practically at once and support therefore even-aged stands; while pastures owing to the competition of the turf are more apt to be recaptured slowly, particularly if grazing takes place upon them, and in consequence their stands are uneven aged.

Transportation of Seed.—The recapture of abandoned fields depends primarily upon the ability of tree seed to reach them in sufficient abundance. The several agencies which aid in its transportation are: (1) wind, (2) birds and animals, (3) gravity, (4) water. Wind is the most important, it being the only one capable of disturbing seed abundantly over large areas. Its action, however, is limited to seeds of light weight with some sort of a winged attachment by which it can grip them. Wind-disseminated seeds are of three classes: (1) Very light thistledown-like seeds such as those of willows and poplars, which will float on light airs and travel for many miles; (2) medium-light seeds such as those of the birches, which can be blown for long distances, but will not float on light airs; and (3) medium-heavy, generally winged, seeds, such as those of the pines, ashes, maples, tulip poplar[1] and many others, which will flutter to the ground except in the face of a considerable breeze, and even then are not apt to travel more than a few hundred yards in sufficient abundance to form a stand. Birds and animals generally limit their activities to the transportation of such seeds (or fruits) as are in whole or part edible (from their points of view). The fruits of the common red cedar and the black cherry are examples. The fruit is eaten by birds and the indigestible seed is deposited wherever they happen to fly. Animals such as squirrels and other rodents generally operate by taking nuts, acorns, etc., from the seed trees or the ground beneath them into the open and burying them for food stores. It is possible that certain birds, for instance the blue jay, also do this. Gravity plays its distinctive part only on sites where heavy seed roll down-hill. Water plays its part in washing seeds down-hill and covering them with earth once they have reached their resting places. The flooding of bottomlands by overflow from streams does not seem ever to leave a sufficient deposit of seed to make any impression after the water has subsided.

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[1] *Liriodendron tulipifera.* With a few exceptions scientific names of trees have been omitted, since common names are so well standardized as to make it unnecessary.

Trees which Succeed in the Capture of Abandoned Fields.—As has already been intimated, a species to succeed in the capture of open fields must have several characteristics, the chief of which is that it must have seed which may easily be transplanted by natural agencies, and is produced regularly and in abundance. After that it is necessary that the species be able to start in the open, and, if necessary, to compete with grassy or brushy vegetation, and to get along with comparatively little moisture. Swamp-loving species seldom succeed well on abandoned fields. The most successful old field species are also rapid growing so that they are able to forge ahead of the brush and worthless growth which often crowds in with or ahead of them. Successful slow-growing species, such as the red spruce and the red cedar, are either very tolerant, so that they are not affected by the light competition, or are early comers and succeed by being the first on the ground. A tree must also be able to grow in closed stands, which some light-seeded species like the ashes are unable to do. On pastures or in sections where stock is allowed to range species which for some reason are objectionable as food plants for the stock have an advantage, since they are less liable to be eaten off or broken down. The tulip poplar seems to be liked by cattle and is in consequence badly damaged where grazing is allowed, while thorny trees like the black locust are almost immune from their attacks, and conifers suffer far less in this way than broad-leaved species.

Difference between Old Field and Natural Forest Types.—

As a result of the requirements necessary for the success of a species in recapturing abandoned fields, it frequently happens that the stands which grow under such conditions differ radically in composition, form, rate of growth and final yield from those of the surrounding natural forest. To the nonprofessional eye the most striking difference is apt to be in the species. Old field trees are in many cases trees which are of subordinate importance in the original forest. In southern New England gray birch and red cedar—the leading old field species of the region—are of rare occurrence in the long-established woodland. In portions of Pennsylvania and New Jersey the scrub oak which frequently takes possession of the old fields seldom rises to the dignity of a tree in the original forest. Further south loblolly pine, a tree of naturally limited distribution in the long-leaf pine region, seeds in abundantly on abandoned fields in that section, to the almost entire exclusion of the long-leaf itself. On the other hand, there are cases where the most important tree in the forest is also the most important old field tree. Old clearings in northern New England frequently seed up to rather dense stands of red spruce, that being the dominant tree in the original forest.

Notwithstanding the occasional similarity of species, the form of the forest is generally quite distinct on old fields from that in the original forest. Virgin forests in most cases tend toward an all-aged form. While we have seen that old fields may be either many-aged or even-aged, they generally approximate the latter. In many long-settled portions of our country the original forest has long since entirely vanished, and the form which has succeeded it differs more or less from it. In southern New England a sprout forest is now the dominant form. The forest which takes possession of the abandoned fields is of necessity of seedling origin, and therefore different fundamentally from the existing form. We might go on naming ways in which old field stands differ from the original or prevailing ones. Yet from the practical viewpoint the most important feature is their rapid growth; not only individual trees, but entire stands make more rapid growth in height and volume than takes place in the natural forest. It takes from 75 to 200 years for red spruce grown in the virgin forest to become merchantable, but old field stands of the same species are frequently merchantable at 60 years. The same acceleration of growth is observable in all old field stands. However, the timber cut from such stands is seldom as high grade as that from the original forest.

Reversion of Old Field Types to Those of the Original Forest.—In every forest region there are two classes of forest types—permanent and temporary. A permanent type is one naturally adapted to the growing site and capable of maintaining itself indefinitely without change of form, and toward which all other types occupying similar sites evolve. It represents a state of equilibrium. If a permanent type is destroyed by fire, clearing or other cause, it is generally succeeded by a forest type of a different sort, but which gradually undergoes a transformation and finally can not be distinguished from the original. Such a type is known as a temporary forest type. Old field types belong to this class. The open-field conditions which favored the establishment of certain species gradually disappear as the area becomes more and more wooded, the crop of light-seeded, quick-growing trees which crowd in at first do not always find the site favorable when forest conditions are fully reestablished. When this has largely or completely taken place the less adaptable species begin to creep in—those which can not start perhaps without some sort of protection, or the heavy-seeded species, the slow-growing ones and the like. After a sufficient time they come up through the first arrivals and partly or completely crowd them out. In northern New England hardwoods, such as birch, beech and maple, creep in among the spruces, till finally about the same porportion of hard and soft woods is obtained as is found in the original forest. In southern New England the oaks and chestnut creep in underneath the gray birch and red cedar and, after the latter have reached their normal height growth, grow up through them and shade them in. Thus the prevailing mixed hardwood type succeeds to the old field type. It is thought to require almost a century from the time the field is first abandoned till it finally passes over completely to the mixed hardwood type. Similarly in parts of New Jersey and Pennsylvania the scrub-oak type changes to one of mixed hardwoods and pine. In the south the reversion of the loblolly to the long-leaf type has not been observed, but, under natural conditions, would be expected to occur in time. It has probably been prevented because lumbering and forest fires have so far swept away the long-leaf that there are not enough trees left to act as seed trees.

Commercial Value of Old Field Stands.—From the practical viewpoint of the forester and the lumberman, old field stands are generally regarded as of much or little value according to their yields of commercial timber. They have little respect for such types as the scrub oak in Pennsylvania and New Jersey and the cedar and gray birch in southern New England. In the former case the type is an unmitigated nuisance and is of no value whatsoever. If it could be kept out, a stand of valuable trees might be secured many years sooner. The cedar and birch type is of little value save what the birch has for cordwood and the cedar for posts. While red cedar makes excellent fence posts and has other uses, its very slow growth renders it unprofitable to encourage it. On the other hand, old field stands of red spruce, white pine, loblolly and short-leaf pine frequently have a high market value.

OLD FIELD STAND OF RED CEDAR IN SOUTHERN CONNECTICUT. Age 1–20 years. One half stocked. Seeding up still in progress.

Aside from the species, much depends upon the form and density of the stands as to their value. Stands which do not seed up thickly enough have few trees and those few of poor form, being short and limby, producing poor knotty lumber. Stands which are too thick produce long slim poles, too small in proportion to their height to make good saw-logs. Sometimes this overstocking is so great that the trees crowd each other so severely that growth almost ceases. The forester is more and more being called upon to remedy one or the other of these conditions. In the first case he recommends the planting up of the vacant spaces with trees of desirable species so as to bring the stand up to full density; in the second, the cutting of enough of the inferior trees to allow proper growing space for the others.

Important Old Field Types.—In conclusion it may be worth while to discuss briefly a few of the more important old field types found in the eastern portions of the country. Starting in the northeastern part of the United States, they are: (1) *red spruce,* (2) *white pine,* (3) *red cedar* and *gray birch,* (4) *scrub oak,* (5) *loblolly pine,* (6) *short-leaf pine,* (7) *tulip poplar and other hardwoods.* Some of these types also occur on cut-over lands, but generally the two classes of sites, even when occurring side by side, exhibit sufficiently different conditions to cause pronounced differences in their forest growth, and the problems of obtaining satisfactory forest regeneration on the two are generally distinct.

Photo by Prof. J. W. Tooney.

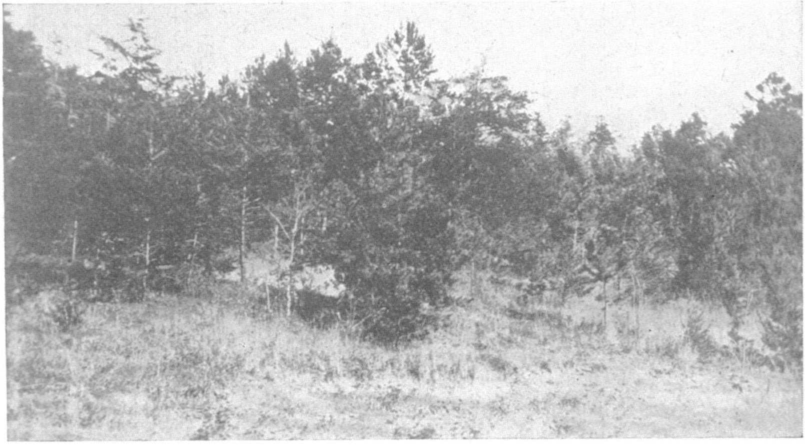
STAND OF OLD FIELD WHITE PINE IN NORTHERN CONNECTICUT. Age 30–35 years. Trees 16 inches in diameter. 70–80 feet high.

1. *The Old Field Spruce Type.*—On hilltops in Vermont, New Hampshire, Maine and northern New York there are many abandoned fields, most of them left vacant when the owners sought more fertile lands in the west. These have been and still are seeding up to a variety of types, but the most characteristic and valuable is the old field spruce type. It is often mixed with a considerable percentage of balsam. These lands in most cases have a commercial value soon after their establishment, since it is from them that the supply of Christmas trees sold in the northeastern United States is so largely derived. At from fifty to sixty years of age they are large enough to be cut for pulp-

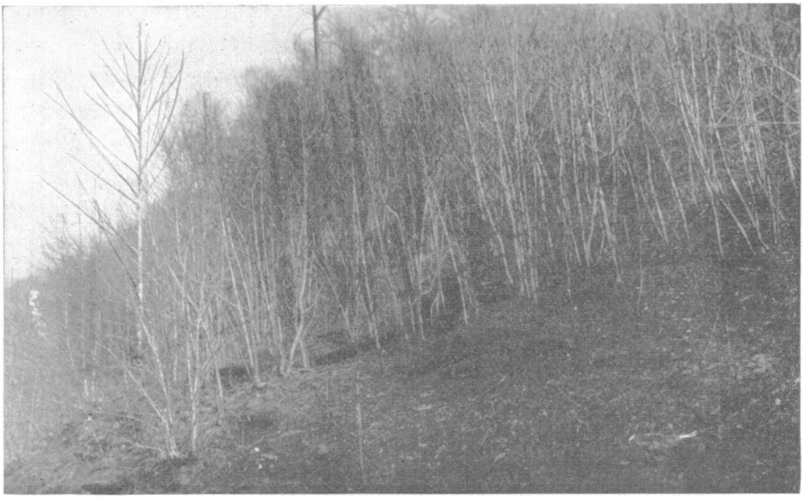
wood and a few years later for lumber. As yet, except for the Christmas-tree yield, this type has no great commercial value since few stands have been long enough established. Its potential value, however, is very great. Frequently these stands are so thickly stocked that a thinning is advisable at from twenty-five to thirty years.

2. *Old Field White Pine Type.*—In southwestern Maine, southeastern New Hampshire, portions of Massachusetts, Rhode Island and northern Connecticut the original forest was largely composed of white pine mixed with a small percentage of hardwoods, although since early times the amount of pine has very greatly diminished. Abandoned fields, however, generally seed up rapidly to comparatively even-aged stands of white pine, although sometimes the pitch pine wholly or partly takes its place. At forty years of age these stands, if their density is full, may yield as high as twenty thousand board feet of lumber to the acre. To-day many such stands are being harvested—the wood being used chiefly in the manufacture of box boards. It is by means of these stands that Massachusetts has been able to maintain her place as one of the leading white-pine producing states.

3. *Red Cedar and Gray Birch Type.*—This type is common in Connecticut, southern New York and portions of northern New Jersey. It is really a combination of two types. The red-cedar type, which comes up very scatteringly over abandoned pastures, and is many years in entirely reclaiming them; and the gray birch type, which often comes up very thickly in a few years after a piece of land is abandoned directly from the plow.



OLD FIELD STAND OF SHORTLEAF PINE IN NORTH CAROLINA. Trees 10 to 20 years old. 20 to 30 feet tall



STAND OF TULYS POPLAR SEEDED IN ON AN ABANDONED FIELD IN THE MOUNTAINS OF EASTERN KENTUCKY. Age 10–20 years. Density full.

These two types are so frequently found mixed in all gradations that they are commonly, as we have seen, treated as one. Its chief value is that it frequently captures a field before it is overrun with a tangle of briers, sumac, sweet fern and other equally worthless plants. It is likewise exceedingly difficult for the forester to handle this type so as to make it yield commercial timber at a reasonable age. One recommendation is to cut it clear and replant it to white pine or some other valuable tree. This is of course expensive, even though as an investment it may yield a good return when the plantation comes to maturity. In addition the owner generally hesitates to sacrifice an already established stand even though its final commercial value is sure to be low. Another plan is to plant up the numerous blanks which generally occur and gradually to thin out the naturally established trees in favor of the more valuable planted ones, meanwhile thinning the spots where the natural stand is too thick, so as to encourage the most desirable of the cedars, and such valuable hardwoods as have become established.

4. *The Scrub-oak Type.*—In parts of Pennsylvania and New Jersey and to a lesser degree in other portions of the eastern United States, a type of non-commercial oak springs up rapidly on abandoned fields. It is hardly worthy of the name of a forest, since it grows to a height of only six or eight feet and forms an almost impenetrable thicket, valueless from every point of view. The acorns of these scrubby oaks, chiefly *Quercus mana* and *prinoides*, are very small and are presumably

carried to the fields by birds and animals. Their habit of growth, which is spreading, causes them to take up more room than trees many times their height. In the course of time moderately tolerant and valuable conifers such as the white pine and hemlock and hardwoods such as various of the standard oaks seed in under this mass of brush and grow up through it. The scrub oak itself is quite intolerant and as the other trees grow above it it is shaded out and disappears. The process of overcoming this pernicious old field type delays the recapture by valuable species from fifty to seventy-five years.

The practise of forestry to aid nature in growing a timber-producing forest on such sites is to plant a desirable species before the scrub oak has gotten possession of the site, or to cut it off and plant it if the oak has already come in. Under planting with tolerant species might succeed, especially if clearings were made about each individual tree as it was planted. Desirable natural growth could also be encouraged by cutting the oak away from it.

5. *Old Field Loblolly Pine Type*—The stands of loblolly pine occurring near the coast from Maryland southward are the most important commercially of any old field stands in the country. Most of them had their origin on cotton fields abandoned during the Civil War. They become merchantable in about forty years, at which time they contain an average of from two hundred and fifty to three hundred trees to the acre, averaging about ten inches in diameter and sixty feet high. The yields average perhaps eight thousand board feet to the acre. The forester can frequently assist in increasing these yields by judicious thinnings in young and middle-aged stands. The timber from this type has already to some extent taken the place of that formerly cut in the same region from the virgin long-leaf stands, which are now all but exhausted.

6. *Old Field Short-leaf Pine Type.*—The original forest of the Piedmont Plateau section of the southern states is a mixture of short-leaf pine and various hardwoods, chiefly oaks. On old fields the pine is apt to seed in rapidly to the exclusion of the hardwoods. Since relatively little land in this section has been abandoned, the commercial value of this type is not yet great. However, short-leaf is a valuable wood and the stands seem to grow rapidly so that they will some time be quite valuable, although it is not likely that sufficient land will ever revert to forest to make them an important source of timber.

7. *Old Field Tulip Poplar Type.*—Abandoned fields in the southern Appalachian Mountains frequently seed up to tulip

poplar—the yellow poplar of the lumbermen and the tulip tree of the botanist—and various other less important broad-leaved trees. Yellow poplar is a highly valuable wood of which the supply is not too great. Since the tree seems to grow with great rapidity on these abandoned fields, such stands are of high potential value, although as yet few of them have reached commercial size. The amount of land abandoned does not give promise of ever being great enough to make such stands an important source of timber.

There are, of course, other old field types, as well as great variations in the ones here described, but those mentioned are the most typical and important, and as time goes on their importance will not be lessened.

Until the final balance is struck between agricultural and forest land in this country—something that seems a long way off—there will always be a certain amount of land passing from one state to the other, and with the growing scarcity of timber the attention of foresters and lumbermen will be increasingly interested in the stands produced on abandoned lands. The forester will be interested in seeing that the proper species are reproduced on them and that they are managed so as to secure full stocking and maximum yield. He will more and more anticipate nature by planting the land to trees as soon as it ceases to be cultivated. The lumberman will turn more and more to those stands for his supply of raw material as the virgin and long-established forests are exhausted.